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Development of decision support system for sheep and goats in the hot / dry area of the north costal zone of Egypt

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Abstract. A Small Ruminant Decision Support System (SRDSS) was developed to improve flock productivity under the arid conditions of the North Costal Zone of Egypt. Field data were collected on 165 flocks to characterize prevailing small ruminant production systems and to identify their biological and economic potentialities and constraints. The SRDSS comprises four modules. The Flock Establishment Module displays housing, utilities, labour, flock structure and preferred breeds that best utilize the breeder resources. The Management Module displays the recommended flock practices during mating, pregnancy, parturition, lamb suckling and weaning. The Feeding Module displays recommended rations for best utilization of range, fodder and crop residues and illustrates technical means to enhance their nutritive value and best utilization of available feed resources. The Production and Marketing Module displays the biological and economic assessment of the flock production and means to improve its productivity and profitability. The SRDSS was verified and validated through local and regional workshops, and was recommended as a useful tool as a vital link between SR expertise, breeders (Bedouins) and extension staff, in remote vulnerable areas.

Keywords. Decision support system – Small ruminant – Dry – Egypt.

Développement d'un système d'aide à la décision pour des troupeaux ovins et caprins de la région chaude et aride de la Côte Nord de l'Egypte

Résumé. Un système d'aide à la décision SRDSS (Small Ruminant Decision Support System) a été développé dans la zone aride de la Côte Nord d'Egypte. Les données de terrain ont été recueillies sur 159 troupeaux afin de caractériser leurs systèmes de production et d'identifier les contraintes de production et leurs potentialités. Le SRDSS est composé de quatre modules. Un module de mise en place du troupeau propose la meilleure utilisation des ressources en capital telles que le logement, l'équipement, le travail, et propose la meilleure structure du troupeau. Un module de gestion du troupeau propose des technologies concernant les pratiques de reproduction, de gestation, de mise bas, d'allaitement et de croissance des jeunes. Un module d'alimentation propose des utilisations optimales d'aliments, de fourrages et de résidus de culture, en plus de paquets techniques pour améliorer leurs valeurs nutritives. Les modules de production et de commercialisation proposent des évaluations techniques et économiques du troupeau et des moyens pour accroître la productivité et sa valorisation sur le marché. Le SRDSS a été validé avec les éleveurs et les agents de vulgarisation dans des ateliers locaux et régionaux, où il a été considéré comme un outil utile de vulgarisation faisant le lien entre les experts des petits ruminants, les éleveurs et les agents de vulgarisation.

Mots-clés. Système d'aide à la décision – Petits ruminants – Aride – Egypte.

I – Introduction and background

Decision Support Systems (DSS) are a class of computer-based information including knowledge based systems that support decision making activities (Manpreet et al., 2008).

DSS have proven to be important tools for technology transfer in agriculture (Rafea, *et al.*, 1995). The present study was carried as a collaborative research between the Animal Production Research Institute (APRI) and the Central Laboratory for Agricultural Decision Support Systems (CLAES), Ministry of Agriculture and International Centre for Agricultural in Dry Areas (ICARDA). The collaborative research aims to develop a Decision Support System for small ruminant production and management in the arid area of the North Coastal Zone of Egypt (NCZ), and communicate it through Internet, hence the project is available on the site: <http://esonline.claes.sci.eg>.

The studied area runs from Alexandria East to the Libyan border West for about 500 km. It is a hot dry area with low rainfall (<150 mm/year). The Eastern region has small areas of newly reclaimed lands with irrigated fodder and crop residues (Shalaby, 1999). The climate, ranges from Mediterranean in the North to semi-arid in the South. Temperature ranges from 23 to 39°C in July and August and from 9 to 18°C in January. Winter is the main raining season starting from mid October to mid March and occasionally in April and May.

Sheep and goats population in the NCZ reaches about one million head, according to the statistics of the Ministry of Agriculture. Most Bedouin producers run sheep and goats together, as their principal livelihood activity, which contribute substantially to the family income and nutrition, and is used as subsistence and strategic reserve in years of drought (Aboul-Naga *et al.*, 2008). It is also an important physical asset, which can be liquidated whenever needed. The Bedouins who depend solely in their livelihood on livestock production with degraded rangelands and unreliable rainfall, facing problems of poverty and food insecurity, are considered as highly vulnerable householders (La Rovere and Aw-Hassan, 2005).

Under the prevailing situation of degraded rangelands, expensive feed concentrates, low productivity of local breeds and low rate of knowledge dissemination, taking right decisions on how to best manage their SR flocks is a sensitive and necessary matter that affects livelihood of millions of householders in such hot / dry conditions. Therefore, development and application of knowledge based SRDSS is crucial in such vulnerable areas.

II – Methodology

The SRDSS has been developed in four modules; Flock Establishment, Flock Management, Feeding and Production & Marketing.

Sources of information on sheep and goat production systems in the studied area, were available from three sources: (i) field data collected on 165 sheep and goats flocks in different regions in the NCZ (Aboul-Naga *et al.*, 2008); (ii) accumulated knowledge available in APRI generated by researchers over the past decades (Aboul-Naga *et al.*, 1986; Aboul-Naga *et al.*, 1988; Almahdy and Metawi, 2000; Ferial Hassan and Shehata, 1990; Metawi, 2001; Metawi *et al.*, 1997); and (iii) knowledge available in the scientific literature.

Prototypes for the SRDSS were established and tested through frequent group meetings with the breeders and extension staff in both Eastern region (Borg Al Arab, El Hamam and El Alamain districts) and Western region (Raas El Hekma, Matrouh and Barani districts) of the NCZ. The developed prototypes were verified according to the feedback comments got from the breeders, extension staff and other stakeholders. SRDSS has been further validated through national workshops with Bedouins and extension officers and experts from APRI and CLAES. Regional workshop was hold by the end of exercise which was attended by experts from Syria, Morocco and Tunisia together with breeders and extension officers and experts from APRI, CLAES, ICARDA and national scientific institutions.

III – Results: the Small Ruminant Decision Support System

1. Flock Establishment Module (Fig. 1)

The Module concerned with establishing new flock and/or expanding existing ones.

Input data (by breeder): Farm location, production objective, management types (settled, transhumance), housing types (open, closed, semi closed), available capital (in Egyptian pounds), targeted flock size (including sheep to goats ratio), preferable breeds of sheep and goats (desert, valley or regional areas), water resource, labors (family or hired).

Output data: Recommended flock structure for sheep and goats, needed housing area (m²), farm facilities and labors required.

Demonstration: display criteria for purchasing males and females based on performance.

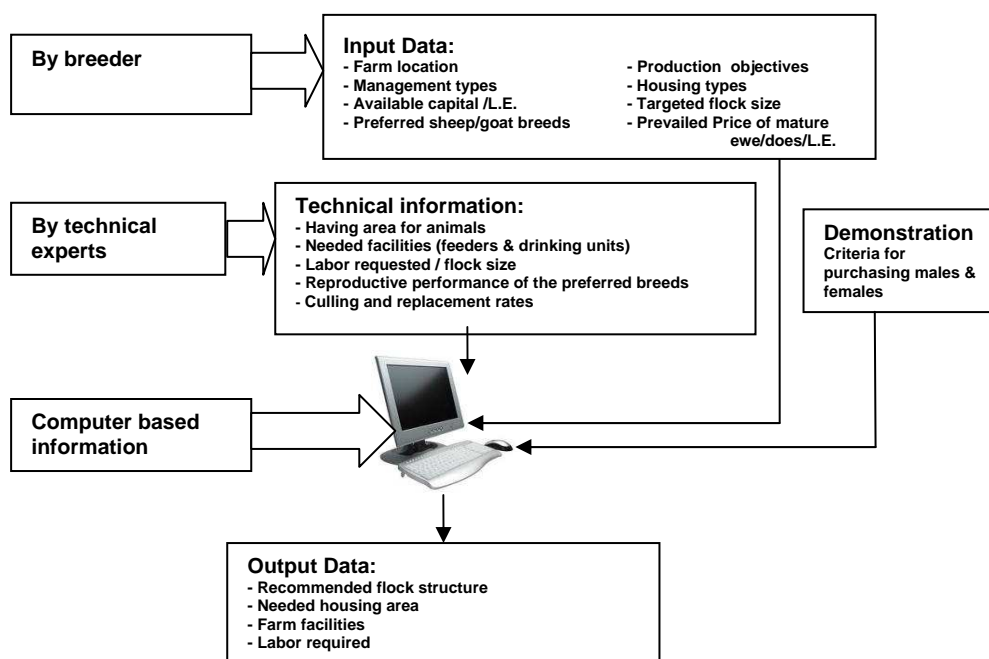


Fig. 1. Flow diagram for Flock Establishment Module.

2. Flock Management Module (Fig. 2)

The Module focuses on flock management at different production status.

Input data: Information on mating system, pregnancy, lambing/kidding, suckling and weaning practices.

Output data: Means for improving fertility and prolificacy; preparation of males & females for mating; males to females ratio, best way of handling at mating; rearing of ewes/does at late pregnancy, at lambing/kidding and during suckling and weaning. In addition, recommendation deals with ways to improve survival of lambs/kids; lambing/kidding interval and health care at different reproduction phases.

Demonstration: Photos and drawings illustrating different technical recommendations.

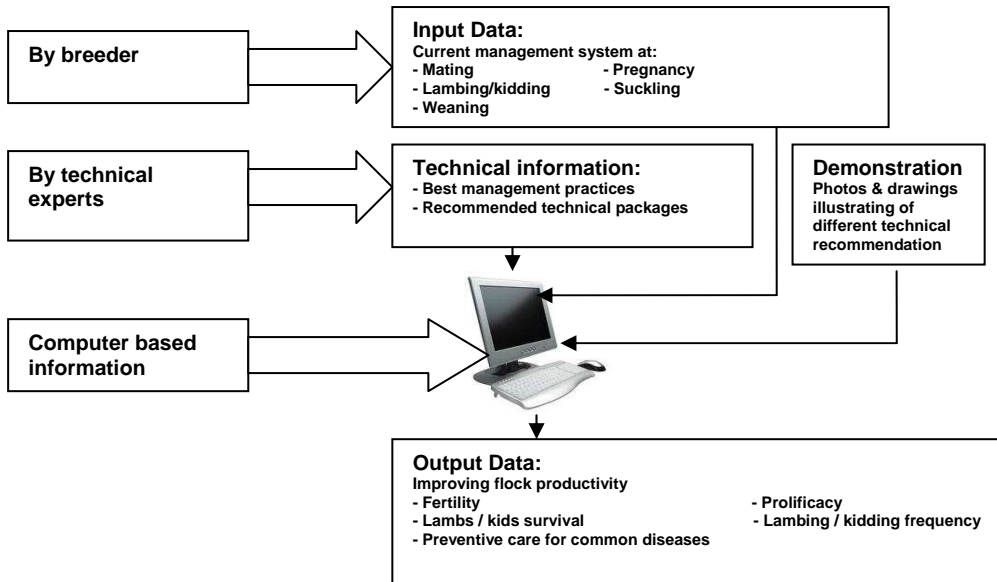


Fig. 2. Flow diagram for Flock Management module.

3. Feeding Module (Fig. 3)

The Module focuses on flock feeding and lambs fattening.

Input data: Available feed stuffs and its prices, range available at the four seasons of the year (February-April, May-July, August-October, November-January) and the production status of the flock.

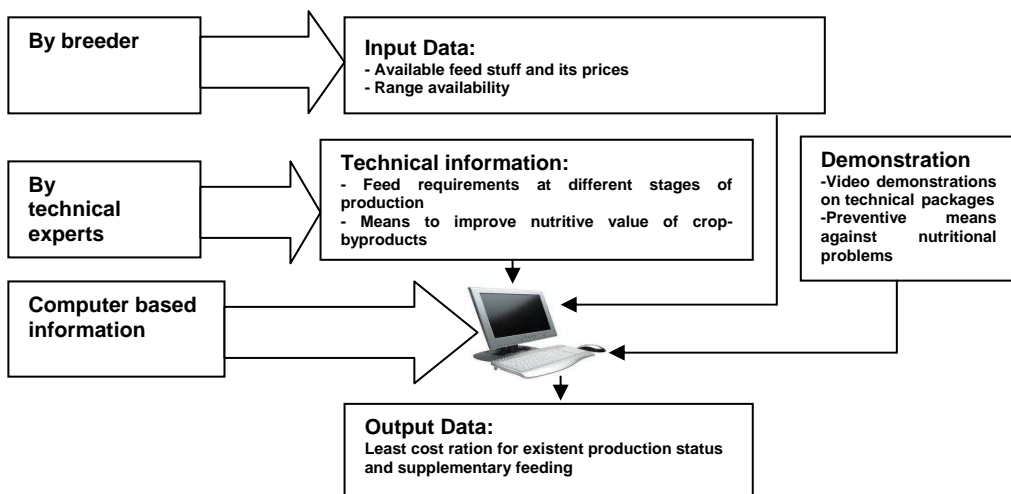


Fig. (3). Flow diagram for Feeding Module.

Output data: Over 100 economic balanced feeding formulas; utilizing available ranges, fodder, crop residues and feed concentrate, for different production status, and supplementary feeding (if needed).

Demonstration: Video demonstrations on technical packages to enhance nutritive value of crop residues and roughages, also preventive means against nutritional problems (urinary Calculi, internal parasites, aflatoxin, etc).

4. Production and Marketing Module (Fig. 4)

The 4th Module of production and marketing utilized different assessment models as follows:

- (i) Flock profitability by cost-benefit and gross margin analysis.
- (ii) Flock productivity, as litter size x 365 / interval between parturitions x survival rate x weaning weight.
- (iii) Biological and economical analysis utilizing Sensitivity Analysis (Pannell, 2009).
- (iv) Break even analysis for females: Annual fixed cost / 1 – (variable cost per unit / output per unit).
- (v) Optimum utilization of inputs, marginal costs.

Input data: flock reproduction performance over the last productive year; females conceived / aborted, females with 2 crops, multi-births, lambs / kids died pre and post weaning and ewes / does disposed and cause of disposal, together with marketing information on lambs / kids (number, weight and price). Information on fattening business included weight and age of lambs / kids at beginning of fattening, fattening period and feed and non feed costs.

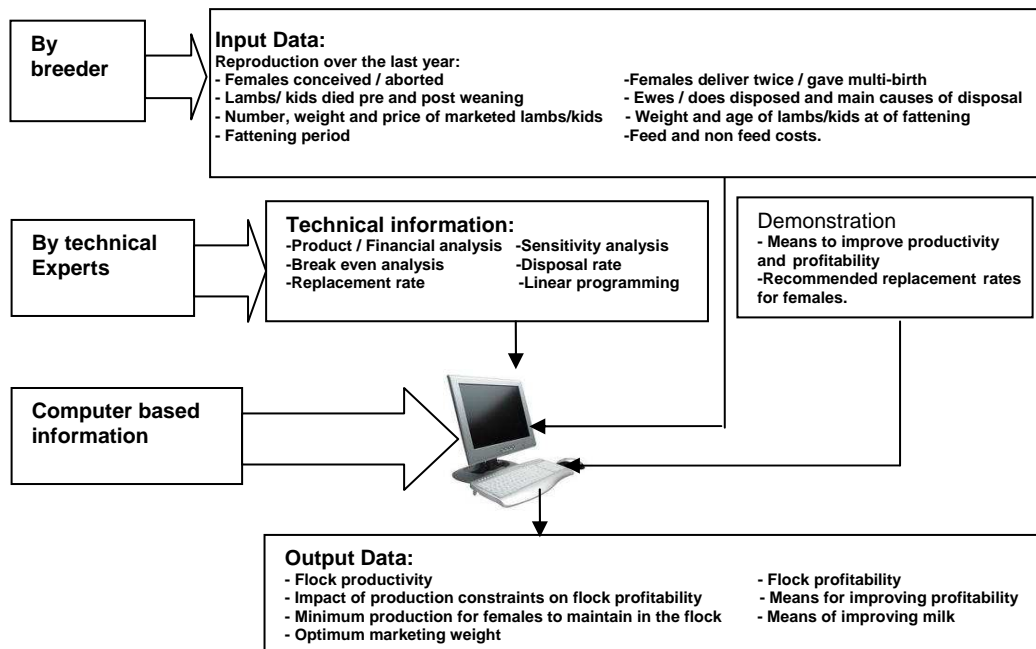


Fig. 4. Flow diagram for Production and Marketing Module.

Output data: Assessment of reproduction performance of the flock, flock profitability, minimum productivity of females to retain in the flock, means to improve flock profitability (increasing production and / or decreasing cost of production and getting better marketing conditions), profitability of fattening process and limiting factors, feed conversion efficiency, means of improving milk production and have to add value to the products.

Demonstration: Means to improve productivity and profitability of the flock and its expected economic impact, recommended replacement rates for females.

IV – Conclusion

The developed SRDSS provides a useful extension tool in the rainfall dry area of NCZ. Moreover, it can play a valuable role in assisting the Bedouins with their decisions regarding flock establishment, management, feeding and means to increase flock productivity and profitability. Ultimately, the success of SRDSS will depend on its adoption by the targeted beneficiaries (breeders, investors and extension officers). An implementation phase will follow this exercise includes training of extension officers and computer illiterate breeders to use the system. Equally important are means to develop more and more friendly user SRDSS as, chatting modes, video films related to the prevailing Bedouins culture, etc. This opens the way to out scale SRDSS to other hot/dry areas in Egypt and other sub-regions in West Asia and North Africa.

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